Answers

SWINBURNE COLLEGE
PATHWAYS PROGRAMS

Examinations: **Semester 3 2007/8** Paper 1 of 1

Campus HAWTHORN

Subject Code: **LFSE003**

Full Subject Title: **CHEMISTRY**

STUDENT'S NAME: _____ ID No: _____

Duration: 2 hour _____ minutes Percentage of overall assessment covered by this paper: 50%

Reading Time: 15 minutes

INSTRUCTIONS TO CANDIDATES

Materials Allowed

Pen, foreign/Standard English and English-Foreign dictionaries with no markings, Non-Programmable calculator.
Standard Linear Graph Paper to be supplied

Answering Requirements
Nil

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SWINBURNE COLLEGE

PATHWAYS PROGRAMS SWINBURNE FOUNDATION STUDIES

Teaching Period: 3 **Year: 2007/8**

Subject Code(s): **LFSE003**

Full Subject Title: **CHEMISTRY**

Teacher: **Peter Dunne**

Student Name: _____

Student ID: _____

Reading Time: 15 minutes

Exam Duration: 120 minutes

DO NOT START WRITING YOUR ANSWERS UNTIL YOU HAVE READ THE INSTRUCTIONS OVERLEAF

x QUESTION & ANSWER BOOKLET

EXAMINER'S USE ONLY		
Questions	**Marks**	**Student Result**
1	8	
2	7	
3	11	
4	2	
5	2	
6	8	
7	4	
8	2	
9	6	
10	4	
11	3	
12	4	
13	8	
14	3	
15	3	
16	2	
17	4	
18	3	
Final Mark		

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SWINBURNE UNIVERSITY OF TECHNOLOGY

READ BEFORE COMMENCING

INSTRUCTIONS:

1. **You should attempt all questions**

2. **Do not use pencil.** Papers submitted in pencil will not be accepted for marking.

3. Write your answers in the space provided.

4. Should you wish to repeat an answer:

   a) Cancel the answer you do not wish the examiner to mark.

   b) Write your revised answer in the space provided for this at the end of the answer booklet. Make sure that the answer is numbered correctly.

5. Do not remove any staples from this paper.

6. Silent battery operated, non-programmable calculators may be used.

7. Candidates may refer to a Foreign Language Translation Dictionary provided that it is not annotated or does not contain definition words. Candidates must **NOT** use electronic dictionaries.
8. Data sheets will be provided

This paper carries 50% of Final Assessment in this subject. Semester assessment carries 50%. You must pass both the exam and the semester assessment to pass the subject.

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Question 1 (2 + 2+2+2+2=~~8~~ marks)

(a) Write chemical formulae for the following:

magnesium chloride $MgCl_2$ (2)

iron(111) sulphate $Fe_2(SO_4)_3$

(b) Write the chemical names for the following

H_2SO_4 sulphuric acid (2)

CuCl copper I chloride

c) Balance the following equations

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ (2)

$4Al + 3O_2 \rightarrow 2Al_2O_3$

d) Write a balanced **molecular** equation for the following reaction:
A solution of potassium sulphite is reacted with a solution of nitric acid to form potassium nitrate solution, water and sulphur dioxide gas.

$K_2SO_3(aq) + 2HNO_3(aq) \rightarrow 2KNO_3(aq) + H_2O(l) + SO_2(g)$ (2)

(e) Write a balanced ionic equation for the following reaction :
a precipitate of lead(11) iodide is formed when solutions of lead(11)nitrate and sodium iodide are mixed

$Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$ (2)

Question 2 (2+3+ 2=7 marks)

In the manufacture of iron, iron(111) oxide reacts with carbon monoxide according to the following equation:

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$

(a) What mass of iron(111) oxide would be needed to make 50 kg of iron ?

$n_{Fe} = \frac{50000}{55.8}$

$2 \times Fe \quad 111.6$
$3 \times O \quad 48$
159.6

Since 1 mol $Fe_2O_3 \rightarrow$ 2 mol Fe (2)

$n_{Fe_2O_3} = \frac{50000}{55.8} \times \frac{1}{2}$

$mass = \frac{50000 \times 159.6}{55.8 \times 2} = 71506\ g = 71.5\ kg$

(b) What volume of CO_2 gas forms at 20 deg C and 105 kPa pressure if 300 gram of iron(111) oxide completely reacts with carbon monoxide ?

$n_{Fe_2O_3} = \frac{300}{159.6} = 1.88$ mol

$\therefore n_{CO_2} = 3 \times 1.88 = 5.64$ mol

$T = 20°C = 293K$

$P = 105\ kPa$

$R = 8.31$

$V = \frac{nRT}{P}$

$= \frac{5.64 \times 8.31 \times 293}{105}\ l$

$= 130.8\ l.$ (3).

(c) If 50 gram of iron(111) oxide is mixed with 50 gram of carbon monoxide, which reactant would be in excess and by how many moles ?

$n_{Fe_2O_3} = \frac{50}{159.6} = 0.313$ mol

$n_{CO} = \frac{50}{28} = 1.786$ mol

Since 1 mol $Fe_2O_3 \equiv$ 3 mol CO

Thus CO is in excess by $(1.786 - (3 \times .313))$ mol

$= 0.846$ mol (2)

Question 3 (6+2+3= 11 marks)
The procedure shown on the following page was written in a student's log book. It describes a procedure to be used in separating and identifying the individual dye components in a commercial food colouring.

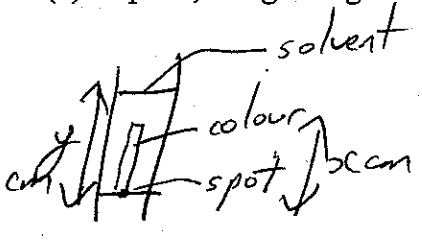
(a) Identify three fundamental errors in the flow chart and in each case explain how the error should be corrected

Error 1 – Don't use felt tip pen to draw line
– use pencil instead

Error 2 – spot should not be 10mm.
– make spot as small as possible (6)

Error 3 – don't have spot covered by solvent
– make sure spot is above solvent

(b) Explain, using a diagram if you wish how Rf values are calculated.



$R_f = \frac{x_{cm}}{y_{cm}}$ (2)

(c) Paper chromatography is only one kind of chromatographic technique. Briefly explain what features are common to all types of chromatography.

– they all have stationary & mobile phase.
– all rely on adsorption and desorption (3)

Procedure

1. Using a felt tip pen, draw a reference line 2 cm from the bottom of a strip of chromatography paper
2. Carefully place a drop of food colouring on the line
3. allow the drop to dry
4. Put more drops of the food colouring over the first to make a concentrated spot that is at least 10 mm in diameter so that it has adequate contact with the paper and can be easily seen.
5. Place a solvent consisting of an ethanol-water mixture in the bottom of a small jar.
6. Hang the strip of chromatography paper in the jar, making sure that the spot of colouring is completely covered by the solvent.
7. Allow the paper to remain in contact with the solvent until a solvent front has almost reached the top of the paper.
8. Observe the separation of the coloured components of the food colouring. Note that the component that absorbs most strongly to the paper pulls itself furthest up the paper.
9. Calculate an Rf value for each spot on the chromatogram.
10. Identify the components of the food by comparing the Rf values with those of known dyes.

Question 4 (2 marks)
What mass of KF is needed to make 2 litres of 0.1M KF solution ?

$n_{KF} = CV = .1 \times 2 = .2$ mol

mass of $KF = n \times M_r$

$= .2 \times 58.1$ g

$= 11.62$ g (2)

K 39.1
F 19
58.1

Question 5 (2 marks)
What volume of 2M hydrochloric acid is needed to make 250 ml of 0.1M hydrochloric acid ?

$C_1V_1 = C_2V_2$

$2 \times V_1 = .1 \times .25$

$V_1 = \frac{.1 \times .25}{2} = .0125$ l (2)

or 12.5 ml

Question 6 (2+1+2+1+2=8 marks)

A new low alcohol beer, "LOALC" was tested for its alcohol(CH_3CH_2OH) content. A 20.00 ml sample was pipetted into a 500ml standard flask and the solution made up to the mark. A 25.00 ml aliquot was titrated against a 0.500 M solution of $Cr_2O_7^{2-}$ and a titre of 8.20 ml was obtained.

The equation for the reaction is:

$2\ Cr_2O_7^{2-}(aq) + 3CH_3CH_2OH(aq) + 16H^+(aq) \rightarrow 4Cr^{3+}(aq) + 11H_2O(l) + 3CH_3COOH(aq)$

(a) How many mole of $Cr_2O_7^{2-}$ was used in the titration?

$n_{Cr_2O_7^{2-}} = CV = \frac{\cdot 500 \times 8 \cdot 20}{1000} = \cdot 0041$ mol (2)

(b) How many mole of CH_3CH_2OH was present in the 25.00 ml aliquot ?

$2\ mol\ Cr_2O_7^{2-} \equiv 3\ mol\ CH_3CH_2OH$

$\therefore n_{CH_3CH_2OH} = \frac{\cdot 0041 \times 3}{2} = \cdot 00615$ mol (1)

(c)What was the alcohol concentration in the aliquot

$\therefore C_{CH_3CH_2OH} = \frac{n}{V} = \frac{\cdot 00615}{\cdot 025} = 0.246M$ (2)

(d)What was the concentration of alcohol in the original sample of beer ?

original conch $= \cdot 246 \times \frac{500}{20} = 6.15M$ (1)

(e) State two safety precautions you should take during this analysis

wear gloves

wear eye goggles (2)

Question 7 (2+2=4 marks)

(a) Calculate the oxidation number of C in each of the following:

CO +2

(2)

Na_2CO_3 +4

(b) For the reaction $Mg + Cl_2 \rightarrow MgCl_2$

which reactant is oxidised ? Give a reason

Mg is oxidised as its O.N. increased from 0 to +2

Question 8 (2 marks)

Write a partial ionic equation for the oxidation of SO_2 to SO_4^{2-}

$SO_2 + 2H_2O \rightarrow SO_4^{2-} + 4H^+ + 2e$

(2)

Question 9 (2+2+2=6 marks)

For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ Kc = 0.58 at 673K

(a) write an expression for Kc for the above reaction

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

(b) calculate the concentration of N_2 at equilibrium given that the equilibrium concentrations of H_2 and NH_3 are 1.32M and 0.50M respectively

$$0.58 = \frac{0.5^2}{[N_2] \times 1.32^3}$$

$$[N_2] = \frac{.25}{.58 \times 2.3} = .187M$$

(c) Using Le Chatelier's principle, explain whether this reaction would shift to the right or the left if the pressure was increased at constant temperature ?

reaction would move to right as there are 2 moles on RHS but 4 moles on LHS

Question 10 (4 marks)

Calculate the pH of the following solutions

(a) 0.3 M HCl(aq)

$pH = -\log_{10}(0.3)$

$= .52$

(b) 0.5 M $Ca(OH)_2$(aq)

$[H^+] = \frac{10^{-14}}{1} = 10^{-14}M$

$pH = -\log_{10} 10^{-14} = 14$ (4)

Question 11 (3 marks)

Calculate the pH and percentage hydrolysis of a 0.20 M hypochlorous acid solution (HOCl) given that the Ka for hypochlorous acid is 7.0×10^{-7}

The equation is : $HOCl + H_2O \rightarrow OCl^- + H_3O^+$

$K_a = \frac{[OCl^-][H_3O^+]}{[HOCl]} = 7 \times 10^{-7}$

$[HOCl] = 0.20M$

$[OCl^-] \simeq [H_3O^+]$ (3)

$\therefore \frac{[H_3O^+]^2}{0.2} = 7 \times 10^{-7}$

$[H_3O^+] = \sqrt{0.2 \times 7 \times 10^{-7}}$

$= .000374$

$pH = -\log_{10} .000374 = 3.43$

$\%\text{ hydrolysis} = \frac{.000374}{0.2} \times 100$

$= .187\%$

Question 12 (2+2=4 marks).

(a) Explain using an equation how sulphur dioxide gas is converted to sulphur trioxide gas

$2SO_2(g) + O_2(g) \xrightarrow[450°C]{V_2O_5 \text{ cat}} 2SO_3(g)$

(b) Why isn't sulphuric acid made by dissolving sulphur trioxide gas in water ?

misting can happen

Question 13 (2 + 3+ 2+1 = 8marks)

During ethene production crude oil undergoes fractional distillation. Selected fractions then enter a cracking furnace.

(a) Why is it necessary to fractionally distil crude oil ?

to separate out different Boiling Point fractions (different lengths of carbon chains) (2)

(b) Name three fractions obtained by ~~from~~ fractional distillation of crude oil and describe one use for each fraction

naphtha, — petrol
Kerosene, — heating
bitumen, — roads
fuel oil — heating

(3)

(c) Reactions of the compound C_2H_4 are shown below:

$CH_2 = CH_2 + X \rightarrow CH_3 - CH_2(Cl)$

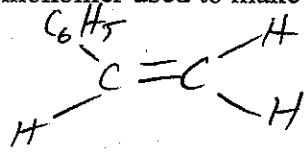
$CH_2 = CH_2 + O_2 \rightarrow Y + H_2O$

(2)

Give the chemical formula of X and Y

X = HCl
Y = CO_2

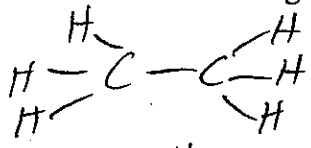
(d) Draw the structural formula of the monomer used to make polystyrene

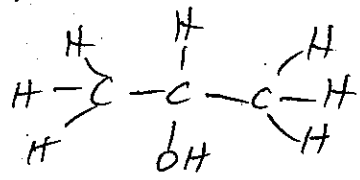


(1)

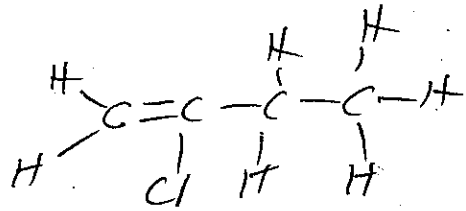
Question 14 (3 marks)

Draw structural formulae for the following compounds

(a) ethane 

(b) 2-propanol 

(3.)

(c) 2-chloro but-1-ene 

Question 15 (3marks)

Name the following organic compounds

(a) C_3H_6 propene

(b) $CH_3-CH_2-CH(OH)-CH_3$ 2-butanol (3)

(c) CH_3CH_2COOH propanoic acid

Question 16 (2 marks)

Give equations, showing all the reactants needed, for the following preparation:

preparation of methanoic acid from methane

$$CH_4 \xrightarrow[\text{light}]{Cl_2 / UV} CH_3Cl \qquad (2)$$

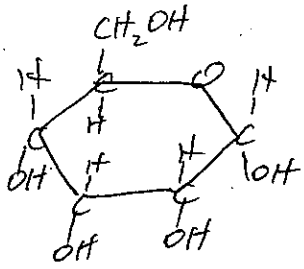
$$CH_3Cl \xrightarrow{OH^-(aq)} CH_3OH$$

$$CH_3OH \xrightarrow[H^+(aq)]{K_2Cr_2O_7(aq)} HCOOH$$

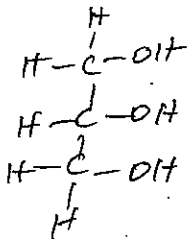
Question 17(4 marks)

Draw the following molecules :

Glucose



Glycerol



Question 18 (2+1=3 marks)

When glycine reacts with alanine a dipeptide forms

(a) Is this reaction an addition reaction or a condensation reaction ? Explain your answer

- condensation
- small molecule is given off in forming new bond

(b) Besides the dipeptide what is the name of the other small molecule formed when this reaction occurs

water